Date: 13-June-2019

To,

Department of Energy and Environment
TERI School of Advanced Studies
Vasant Kunj, Institutional Area
Delhi - 110070
India

Dear Sir/Madam,

My name is Amulya Chevuturi, and I am writing this cover letter to describe my background, experience and skills for consideration of my candidature for faculty position at Department of Energy and Environment, TERI School of Advanced Studies in the area of Climate Modelling. I am a post-doctoral research scientist at National Centre for Atmospheric Science, Department of Meteorology, University of Reading, UK. In my 3-year post-doctoral position, I have worked under the Monsoon Mission project with Dr. Andrew Turner and in Climate Science for Service Partnership China and Brazil projects with Dr. Nicholas Klingaman. Previously, I completed my doctorate, titled "Study of Precipitating Events over India", from Jawaharlal Nehru University (JNU), India under the supervision of Prof. A.P. Dimri. I am an alumnus of TERI School of Advanced Studies, as I completed my Master's in Environmental Studies here in 2009.

My doctorate was focused on examining the meteorological triggers, evolution, and propagation of extreme precipitating events over India using high resolution modeling (with WRF model). My first post-doctoral project focused on analyzing skill of UK Met Office seasonal forecast model in predicting Indian monsoon onset using various statistical skill scores. In my next project, I analyzed impacts of future global warming on temperature and precipitation over Asian-Australian monsoon region, and on regional moisture budgets over East Asia, in-light-of the Paris Agreement. Under my current projects, I am evaluating the conditional forecast skill for Brazilian precipitation based on large-scale circulation variability and the precipitation associated with the seasonal migration of the Meiyu frontal rainband over East Asia. Supplementary to my project research deliverables, I am in involved in other research endeavors in collaboration with the UK Met Office and ECMWF. I have also been part of a successful research grant to study the "Indian Easterly Jet", an as-yet unstudied circulation pattern that appears over India during spring. In future, I would like to continue research into local-scale Indian monsoon and its onset progression, with an aim to improve sub-seasonal forecasts and study its projected changes in the future climate.

During my research career I have published multiple journal articles, book chapters and have also co-authored a book. I have developed good expertise on monsoon systems and their

teleconnections, extreme precipitation events, sub-seasonal to seasonal forecasting and climate modelling. My career has provided me with extensive knowledge of precipitation patterns, moisture budgets, numerical weather and climate modelling, atmospheric data analysis and various statistical methods. My teaching experience includes supervising post-graduate and under-graduate students' dissertations at JNU and University of Reading. I have held a guest lecturer position at Lady Irwin College, Delhi University, teaching courses on climate change to Master's students and supervising them through their research dissertations. I also assisted my Ph.D. supervisor in teaching post-graduate students. My diverse background and skills will provide me a holistic view towards research and help me adapt well to teaching responsibilities.

With specific reference to my experience I think I would be an asset to the faculty position with a research focus. Armed with my experience and good team work skills, I hope I would be able to contribute suitably to the department. I would also like to be part of encouraging and guiding students through this very exciting field of science. I am a self-motivated, pragmatic, result driven person and can handle projects independently. But I also have successful international collaborations at institutions like Purdue University, KAUST (Saudi Arabia), UK Met Office and ECMWF. Further, I am actively involved in outreach activities to schools and media here in UK. I hope to get an opportunity that will assist me to teach students as well as broaden my research horizon. I am confident that I will contribute my best to this institution, if provided the opportunity.

Please find my curriculum vitae and the first pages of my five recent papers (three first-author and two co-author) attached. I appreciate your time and effort in reviewing my application and look forward to hearing from you. Thank you for your consideration.

Best regards,

Amulya Chevuturi

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AMULYA CHEVUTURI

PERSONAL INFORMATION

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Nationality	India
ORCID	orcid.org/0000-0003-2815-7221
Webpage	http://www.met.reading.ac.uk/userpages/rn912700.php
Date of Birth	13 February 1987

PROFESSIONAL EXPERIENCE

Post-Doctoral Research Scientist — 2016-Present

- **Institute:** National Centre for Atmospheric Science (NCAS), Department of Meteorology, University of Reading, Reading, UK.
- **Projects**
  - Process Evaluation of Regional Chinese Hydrological and Atmospheric Natural Climate Extremes (PERCHANCE) under Climate Science for Service Partnership China (2018-2020)
  - Diagnosing and Understanding Brazilian Subseasonal Tropical and Extratropical Processes (DUBSTEP) under Climate Science for Service Partnership Brazil (2018-2020)
  - Drivers of Regional East Monsoon Variability (DREAM) under Climate Science for Service Partnership China (2017-2018)
  - Indian Monsoon Subseasonal and Seasonal Forecasting under Monsoon Mission (2016-2018)
- **Supervisors and Collaborators**: Nick Klingaman, Andrew Turner, Steve Woolnough, Pier-Luigi Vidale, Kevin Hodges, Reinhard Schiemann, Chris Holloway, Emily Black (University of Reading), Gill Martin (UK Met Office), Antje Weisheimer, Stephanie Johnson, Retish Senan (ECMWF).

Teaching Experience

- **Supervision** of M.Sc. thesis at Department of Meteorology, University of Reading (2017-Present).
- **Teaching Assistant** to Dr. A.P. Dimri (2012-2014) at School of Environmental Sciences, Jawaharlal Nehru University for co-supervision of Master of Science and Master of Philosophy dissertations and assisting in teaching the module on Atmospheric processes.
- **Guest Lecturer** (2009-2010) and **External Examiner** (2013) for Master's in Environmental Management & Sustainable Development (Climate Change, Ecosystem and Society course) at Department of Resource Management and Design Application, Lady Irwin College, Delhi University, New Delhi, India

Environmental Consultant — Jan2009-Jul2009

- **Company:** Emergent Ventures India Pvt. Ltd., Gurgaon, Haryana, India
  - **Role:** Review/documentation of emission trading projects for regulated and voluntary markets

ACADEMIC EXPERIENCE

Ph.D. (Supervisor: Dr. A.P. Dimri) — 2009-2015

- **Institute:** School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India
  - **Thesis Title:** Study of precipitating events over India
  - CGPA: 8.4/9.0 (In mandatory Ph.D. course work)

- **Research Collaborations:** Dr. Someshwar Das (India Meteorological Department), Dr. Udaya Bhaskar Gunturu (King Abdullah University of Science and Technology), Dr. Dev Niyogi (Purdue University) and Dr. Anil Kumar (NOAA)

Master of Sciences (Environmental Studies) 2007-2009

- **Institute:** The Energy Research Institute (TERI) School of Advanced Studies, New Delhi, India
  - **CGPA:** 8.6/10.0
  - Dissertation Title: Understanding carbon market projects and their sustainability assessment through MATA-CDM tool (Supervisors: Dr. VVN Kishore, TERI SAS, and Dr. Atul Singhal, Emergent Ventures India Pvt. Ltd.)
  - Project Title: Conventional Solar Technologies and Hybrid PV/T Systems: Review and Comparison (Supervisor: Dr. Suresh P. Babu, TERI Technologies Ltd.)

Bachelor of Sciences (Zoology Honours) 2004-2007

- **Institute:** Sri Venkateswara College, Delhi University, New Delhi, India
  - **Score:** 78.9%

PUBLICATIONS & CONFERENCES

Articles

- Klingaman NP, Chevuturi A, Guo L, Young M, Woolnough SJ, Holloway C, Black E, Vidale PL, Guimaraes B, Coelho C (2019) Assessment of prediction skill for sub-seasonal rainfall variability over South America in ensemble-based prediction systems, *Weather and Forecasting*, in prep.
- Chevuturi A, Klingaman NP, Turner AG, Guo L, Pier Luigi Vidale (2019) Projected changes in the East Asian moisture budget for different levels of future global warming. *Earth's Future*, in prep.
- Chevuturi A, Turner AG, Johnson S, Weisheimer A, Stockdale T (2019) Indian monsoon and its onset seasonal forecasting skill in the ECMWF seasonal forecasting system (SEAS5). *Climate Dynamics*, in prep.
- Shonk J, Chevuturi A, Turner AG (2019) Mechanisms of Indian Summer Monsoon change in the HAPPI experiments, *Climate Dynamics*, in prep.
- Chevuturi A, Turner AG, Woolnough SJ, Martin G, MacLachlan C (2019) Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2). *Climate Dynamics*, 52(11): 6599-6617, DOI: 10.1007/s00382-018-4536-1.
- Guo L, van der Ent RJ, Klingaman NP, Demory M-E, Vidale PL, Turner AG, Stephan CC, Chevuturi A (2019) Moisture sources for East Asian precipitation: mean seasonal cycle and interannual variability, *Journal of Hydrometeorology*, 20: 657–672, DOI: 10.1175/JHM-D-18-0188.1.
- Martin GM, Chevuturi A, Comer RE, Dunstone N, Scaife AA, Zhang D (2018) Predictability of South China Sea Summer Monsoon onset, *Advances in Atmospheric Sciences*, 36(3): 253-260, DOI: 10.1007/s00376-018-8100-z.
- Chevuturi A, Klingaman NP, Turner AG, Hannah S (2018) Projected changes in the Asian-Australian monsoon region in 1.5°C and 2.0°C global-warming scenarios. *Earth's Future*, 6: 339-358, DOI: 10.1002/2017ef000734.
- Chevuturi A, Dimri AP, Thayyen RJ (2018) Climate Change over Leh (Ladakh), India. *Theoretical and Applied Climatology*, 131(1–2): 531–545, DOI: 10.1007/s00704-016-1989-1.

- Dimri AP, Chevuturi A, Niyogi D, Thayyen RJ, Ray K, Tripathi SN, Pandey AK, Mohanty UC (2017) Cloudbursts in Indian Himalayas: A review. *Earth-Science Reviews*, 168: 1-23, DOI: 10.1016/j.earscirev.2017.03.006.
- Chevuturi A, Dimri AP (2015) Investigation of Uttarakhand (India) disaster- 2013 using Weather Research and Forecasting model. *Natural Hazards*, 82(3): 1703–1726, DOI: 10.1007/s11069-016-2264-6.
- Chevuturi A, Dimri AP, Das S, Kumar A, Niyogi D (2015) Numerical simulation of an intense precipitation event over Rudraprayag in the Central Himalayas during 13-14 September 2012. *Journal of Earth System Sciences*, 124(7): 1545-1561, DOI: 10.1007/s12040-015-0622-5.
- Chevuturi A, Dimri AP (2015) Intercomparison of physical processes associated with winter and non-winter hailstorms. *Modeling Earth Systems and Environment*, 1(3): 1-9, DOI: 10.1007/s40808-015-0014-5.
- Chevuturi A, Dimri AP, Gunturu UB (2014) Numerical simulation of a rare winter hailstorm event over Delhi, India on 17 January 2013. *Natural Hazards and Earth System Sciences*, 14: 3331-3344, DOI: 10.5194/nhess-14-3331-2014.
- Dimri AP, Chevuturi A (2014) Model sensitivity analysis study for western disturbances over the Himalayas. *Meteorology and Atmospheric Physics*, 123: 155-180, DOI: 10.1007/s00703-013-0302-4.
- Chevuturi A, Dimri AP (2013) Rudraprayag cloudburst 13 - 14 Sept. 2012. *Vayu Mandal*, 39(1-2): 25-34, ISBN: 0970-1397.

Books/Book Chapters

- Dimri AP, Chevuturi A (2016) Western Disturbances – An Indian Meteorological Perspective. *Springer International Publishing*, DOI: 10.1007/978-3-319-26737-1, ISBN: 978-3-319-26735-7.
- Chevuturi A, Dimri AP, Gunturu UB (2015) Winter Hailstorm over New Delhi, India. *Geostatistical and Geospatial approaches for the characterization of the natural resources in the environment: Challenges, Processes and Strategies*, Springer International Publishing, pp. 867-871, Eds: Janardhana RN, DOI: 10.1007/978-3-319-18663-4.
- Chevuturi A, Dimri AP (2014) Numerical Simulation of a hailstorm event over Delhi, India on 28Mar2013. *High Impact weather events over SAARC region*, Springer Intl. Publishing, pp. 49-61, Eds: Ray K, Mohapatra M, Bandyopadhyay BK, Rathore LS, DOI: 10.1007/978-3-319-10217-7_4.

Presentations

- Chevuturi A, Turner AG, Woolnough SJ, Martin G, MacLachlan C, Volonté A, Milton SF: Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2). *The Australian Meteorological and Oceanographic Society Annual Meeting and the International Conference on Tropical Meteorology and Oceanography (AMOS-ICTMO 2019)*. Darwin, Australia,11-15Jun2019 (poster presentation).
- Chevuturi A, Klingaman NP, Turner AG, Hodges KI, Schiemann R, Guo L, Curio J: East Asia monsoon fronts and associated precipitation: Impact of horizontal model resolution in the UK Met Office Unified model. *CSSP China 5th UK Science Workshop*, Exeter, UK, 21-22May2019 (poster presentation).
- Chevuturi A, Guo L, Klingaman NP, Shonk J, Turner AG, Vidale PL: Projected changes in the Asian monsoon in a 1.5°C warmer world and beyond. *Invited Talk at Indian Institute of Technology - Delhi*. Delhi, India 18Apr2019 (oral presentation).
- Chevuturi A, Klingaman NP, Turner AG, Hodges KI, Schiemann R, Guo L, Curio J: East Asia monsoon fronts and associated precipitation: Impact of horizontal model resolution in the UK Met Office Unified

model. *European Geosciences Union General Assembly 2019*, Vienna, Austria, 7-12Apr2019 (poster presentation).

- Chevuturi A, Guo L, Young M, Klingaman NP: Assessment of prediction skill for sub-seasonal rainfall variability over Brazil in ensemble-based prediction systems. *Workshop on Predictability, dynamics and applications research using the TIGGE and S2S ensembles*. ECMWF, Reading, UK 2-5Apr2019 (oral presentation)
- Chevuturi A, Guo L, Klingaman NP, Turner AG, Vidale PL: Projected changes in the Asian monsoon in a 1.5°C warmer world and beyond. *LASG Seminar*. Institute of Atmospheric Physics (IAP), Beijing, China 21Mar2019 (oral presentation).
- Chevuturi A, Klingaman NP, Turner A, Hodges K, Schiemann R, Guo L, Curio J: East Asia monsoon fronts and associated precipitation in observations and the UK Met Office Unified Model. *Workshop on Water Cycle over East Asia*. Institute of Atmospheric Physics (IAP), Beijing, China 19Mar2019 (oral presentation).
- Chevuturi A, Guo L, Klingaman NP, Shonk J, Turner AG, Vidale PL: Projected changes in the Asian monsoon in a 1.5°C warmer world and beyond. *Lunchtime Seminar*. Department of Meteorology. Reading, UK 19Feb2019 (oral presentation).
- Chevuturi A, Guo L, Young M, Klingaman N: Assessment of conditional forecast skill for Brazilian precipitation. *CSSP Brazil UK Workshop.* UK Met Office, Exeter, UK, 5-7Feb2019 (oral presentation).
- Chevuturi A, Klingaman NP, Turner AG, Hannah S: Projected changes in the Asian-Australian monsoon region in 1.5°C and 2.0°C global-warming scenarios. *Networking Workshop on South Asian Extreme Climate Research Networking to Inform Adaptation and Mitigation Policies*. Dhaka, Bangladesh, 9-10Oct2018 (oral presentation).
- Chevuturi A, Turner AG, Woolnough SJ, Martin G, MacLachlan C: Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2), *Atmospheric Science Conference 2018: Weather, Climate and Air Quality*, York, UK, 3-4Jul2018 (oral presentation).
- Chevuturi A, Klingaman NP, Turner AG, Hannah S: Projected changes in the Asian-Australian monsoon region in 1.5°C and 2.0°C global-warming scenarios. *European Geosciences Union General Assembly 2018*, Vienna, Austria, 8-13Apr2018 (oral presentation).
- Chevuturi A, Turner AG, Woolnough SJ, Martin G, MacLachlan C: Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2), *NCAS Staff Conference 2018*, Manchester, UK, 6-7Feb2018 (poster presentation).
- Chevuturi A, Turner AG, Woolnough SJ, Martin G: Evolution of Indian land surface biases in the seasonal hindcasts from the Met Office Global Seasonal Forecasting System GloSea5. *European Geophysical Union General Assembly 2017*, Vienna, Austria, 23–28Apr2017 (poster presentation).
- Chevuturi A, Turner AG, Woolnough SJ: Evolution of Indian Ocean biases in the summer monsoon season hindcasts from the Met Office Global Seasonal Forecasting System GloSea5. *AGU Fall Meeting*, San Francisco, United States of America, 12-16Dec2016 (poster presentation).
- Chevuturi A, Dimri AP, Gunturu UB: Winter Hailstorm over New Delhi, India. *16th Annual Conference of the International Association for Mathematical Geosciences on Geostatistical and Geospatial approaches for the characterization of the natural resources in the environment: Challenges, Processes and Strategies*, JNU, New Delhi, India, 17-20Oct2014 (poster presentation).

- Chevuturi A, Dimri AP: Numerical Simulation of a hailstorm event over Delhi, India on 28Mar2013. *SAARC Seminar on High Impact Weather events and their prediction over SAARC region*, New Delhi, India, 2-4Dec2013 (oral presentation).
- Chevuturi A, Dimri AP: Rudraprayag Cloudburst 13 - 14 Sep 2012. *TROPMET-2012 National Symposium on Frontiers of Meteorology with special reference to the Himalaya*, Indian Institute of Remote Sensing, Dehradun, India, 20-22Nov2012 (oral presentation).
- Dimri AP, Chevuturi A: Wintertime Climatic Trends Analysis over glaciers in the Himalayas. *Brainstorming meeting on Himalayan Climate and Glaciers*, Indian Institute of Technology - Delhi, 15-6Feb2010 (oral presentation).
- Chevuturi A, Singh A: Renewable Energy in India - Wind Energy. *International Workshop on the role of Germany and India in Climate Protection, Renewable Energy Policy and Waste Recycling Strategies*, Freie Universitat, Berlin, Germany, 29Sep-10Oct2008 (oral presentation).
- Regular oral presentations at different external/project meetings (viz. Monsoon working group meetings, Seasonal review and preview discussion meeting).
- Regular oral presentations at different intra-departmental meetings (viz. Tropical Hour).

Peer-Review/Reports/Blogs/Interview

- Peer-reviewed multiple articles for scientific journals (e.g. Atm. Sci. Lett., Clim. Change, Geomorph., Clim. Dyn., MAAP, JGR-Atm., GLOPLACHA).
- Interviewed by DownToEarth about Hailstorms (2019), downtoearth.org.in/interviews/environment/-warmer-future-can-lead-to-heavier-hailstorms--63196.
- Chevuturi A (2018) Thoughts on Standing up for Science workshop in London, Department of Meteorology Blog, blogs.reading.ac.uk/weather-and-climate-at-reading/2018/thoughts-on-standing-up-for-science-workshop-in-london/.
- Chevuturi A, Devi RM, Dimri AP (2017) Study of Kedarnath disaster, 2013, *Lessons from Nepal's earthquake for the Indian Himalayas and the Gangetic Plains*, Central Himalayan Environment Association, pp. 45-73. Eds: Singh SP, Khanal SC, Joshi M.

Meetings/Workshops/Visits

- *CSSP China Visit* to Institute of Atmospheric Physics (IAP), Beijing, China (19-22Mar2019).
- *UK CIMP6 Workshop*, Säid Business School, Oxford, UK (27Feb2019).
- *Flooding from Intense Rainfall Programme Open Event*, London, UK (27Nov2018).
- *Outreach event on IPCC Special Report on 1.5 Degrees (SR15)*, Dhaka, Bangladesh (9Oct2018).
- *NCAS Summer Staff Meeting 2018*, York, UK (2Jul2018)
- *CSSP Brazil Workshop* at UK Met Office, Exeter, UK (25-27Jun2018)
- *CSSP China 5th UK Science Workshop* at UK Met Office, Exeter, UK (16-17May2018)
- *Monsoon Mission Review Meeting* by Ministry of Earth Sciences at Indian Institute of Tropical Meteorology, Pune, India (17-18Feb2017)
- *High Impact Weather and Climate Conference* by Royal Met Soc./NCAS at University of Manchester, Manchester, UK (6-8Jul2016).
- *Environmental Pollution and Bioremediation* by School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India (28-29Dec2011)
- *Delhi sustainable development summit - Towards Copenhagen: an equitable and ethical approach (DSDS 2009)* by World Sustainable Development Forum, New Delhi, India (5-7Feb2009)
- *Indian Youth Summit on Climate Change*, Infosys campus, Hyderabad, India (7-10Aug2008)

Training/Courses

- *Introduction to Writing Successful Research Proposals* by University of Reading, UK (12Jun2019)
- *Research Staff Conference 2019,* University of Reading, Reading, UK (16Jan2019).
- *Scientific writing and publishing* by Nature Masterclass, Online, (2018)
- *An introduction to Wikipedia editing - hands-on workshop* by University of Reading, UK (14Dec2017)
- *Standing up for Science media workshop* by Sense about Science at Royal Pharmaceutical Society, London, UK (30Nov2017)
- *NCAS Data Analysis Tools Training* by NCAS-CMS at Reading University, UK (21Sep2017)
- *Fortran Modernization Workshop* by Numerical Algorithms Group (NAG) at University of Reading, UK (13-14Feb2017)
- *Rose/Cylc UM Conversion Course* by NCAS-CMS at University of Reading, UK (15Sep2016)
- *UM training course* by NCAS-CMS at Reading University, UK (13-15Apr2016)
- *Summer (SERB) School on "Weather and Climate in Tropics"* by Indian Institute of Technology and Department of Science and Technology, India (03-26Jun2013)
- *Pre-symposium tutorial on "Satellite observations for regional climate modelling"* by Indian Institute of Remote Sensing, Dehradun and Indian Meteorological Society, India (18-19Nov2012)
- *How to write for and get published in scientific journals and publish manuscripts* by Springer and Edanz at Jawaharlal Nehru University, New Delhi, India (27Aug2012)
- *Bioinformatics course* by IIT-Delhi and SVC, Delhi University, New Delhi, India (2006-2007)

ACHIEVEMENTS

Funding/Fellowships/Honours

- **Funding** - Co-PI in Undergraduate Research Opportunities Programme (UROP) 2019 for a project titled: The “Indian Easterly Jet” and Its Effects on Weather and Climate.
- **Scholarship** - Junior/Senior Research Fellowship by Centre for Scientific and Industrial Research (CSIR), India for Doctoral studies (2010-2015).
- **Scholarship** - UGC Scheme of Fellowship by University Grants Commission (UGC), India at Jawaharlal Nehru University (2009-2010).
- **Fellowship** - DAAD (German Academic Exchange Service) supported academic exchange programme with Freie University, Berlin, Germany (2008).
- **Awards** during three years of B.Sc. Zoology Hons. (2004-2007).

Membership of Professional Societies

- Fellow of Royal Meteorological Society 2019-Present
- Member of Royal Meteorological Society 2017-2019
- Member of European Geophysical Union 2017-Present
- Member of American Geophysical Union 2016-2017

Merit Certifications

- **National Eligibility Test for Lectureship** (Earth, Atmospheric, Ocean and Planetary Sciences) - Centre for Scientific and Industrial Research (CSIR), India
- **National Eligibility Test for Lectureship** (Environmental Sciences) - University Grants Commission (UGC), India

Outreach

- **STEM Ambassador** (2017-present)
- **School student engagement** – as part of Department of Meteorology, University of Reading

Extra-Curricular Activities

- **First-Aider** - University of Reading 2016-onwards (3-year certification).
- **Editorial Board** - Earth Day Annual Edition, Dhara 2012, School of Environmental Sciences, Jawaharlal Nehru University.
- **President, Vice President and Executive Member** - Zoological Society for the academic years 2004-2007, Sri Venkateswara College, Delhi University.

EXPERTISE

- **Research** - Monsoon Dynamics, Climate Change over Tropics, Moisture Budget, Extreme Events
- **Computational** - Atmospheric Models (Weather Research and Forecasting Model, UK Met Office Unified Model), Programming Languages (FORTRAN, Python), Software Packages (GrADS, CDO), High Performance Computing (Parallel/Serial, Cluster scheduling), Operating Systems (Windows, LINUX), Other (Microsoft Office, LaTeX)
- **Languages -** English (professional), Hindi (native), Telugu (fluent), Sanskrit (basic)

REFERENCES

- **Dr. Andrew G. Turner**
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- **Dr. Nicholas P. Klingaman**
  Department of Meteorology, University of Reading, Reading, RG6 6BB, UK
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- **Prof. A. P. Dimri**
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Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2)

Amulya Chevuturi[1,2] · Andrew G. Turner[1,2] · Steven J. Woolnough[1,2] · Gill M. Martin[3] · Craig MacLachlan[3]

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Abstract

Accurate and precise forecasting of the Indian monsoon is important for the socio-economic security of India, with improvements in agriculture and associated sectors from prediction of the monsoon onset. In this study we establish the skill of the UK Met Office coupled initialized global seasonal forecasting system, GloSea5-GC2, in forecasting Indian monsoon onset. We build on previous work that has demonstrated the good skill of GloSea5 at forecasting interannual variations of the seasonal mean Indian monsoon using measures of large-scale circulation and local precipitation. We analyze the summer hindcasts from a set of three springtime start-dates in late April/early May for the 20-year hindcast period (1992–2011). The hindcast set features at least fifteen ensemble members for each year and is analyzed using five different objective monsoon indices. These indices are designed to examine large and local-scale measures of the monsoon circulation, hydrological changes, tropospheric temperature gradient, or rainfall for single value (area-averaged) or grid-point measures of the Indian monsoon onset. There is significant correlation between onset dates in the model and those found in reanalysis. Indices based on large-scale dynamic and thermodynamic indices are better at estimating monsoon onset in the model rather than local-scale dynamical and hydrological indices. This can be attributed to the model's better representation of large-scale dynamics compared to local-scale features. GloSea5 may not be able to predict the exact date of monsoon onset over India, but this study shows that the model has a good ability at predicting category-wise monsoon onset, using early, normal or late tercile categories. Using a grid-point local rainfall onset index, we note that the forecast skill is highest over parts of central India, the Gangetic plains, and parts of coastal India—all zones of extensive agriculture in India. El Niño Southern Oscillation (ENSO) forcing in the model improves the forecast skill of monsoon onset when using a large-scale circulation index, with late monsoon onset coinciding with El Niño conditions and early monsoon onset more common in La Niña years. The results of this study suggest that GloSea5's ensemble-mean forecast may be used for reliable Indian monsoon onset prediction a month in advance despite systematic model errors.

Keywords Indian summer monsoon · Monsoon onset · GloSea5-GC2 · Forecast skill · ENSO

1 Introduction

The Asian summer monsoon is a large-scale phenomenon directly impacting one third of the world's population with further influence on the global circulation. The monsoon over India, during the months of June, July, August and September (JJAS), provides approximately 80% of annual precipitation for the country. The precipitation brings respite from frequent heatwaves during the drier pre-monsoon season. Forecast of monsoon rainfall, its onset, advance and withdrawal are important for the rainfed agriculture sector. Prediction of the monsoon onset provides highly significant information for agricultural planning during the Kharif cropping season in July (Gadgil and RupaKumar 2006). Such

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00382-018-4536-1) contains supplementary material, which is available to authorized users.

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Moisture Sources for East Asian Precipitation: Mean Seasonal Cycle and Interannual Variability

LIANG GUO

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ABSTRACT

This study investigates the moisture sources that supply East Asian (EA) precipitation and their interannual variability. Moisture sources are tracked using the Water Accounting Model-2layers (WAM-2layers), based on the Eulerian framework. WAM-2layers is applied to five subregions over EA, driven by the ERA-Interim reanalysis from 1979 to 2015. Due to differences in regional atmospheric circulation and in hydrological and topographic features, the mean moisture sources vary among EA subregions. The tropical oceanic source dominates southeastern EA, while the extratropical continental source dominates other EA subregions. The moisture sources experience large seasonal variations, due to the seasonal cycle of the EA monsoon, the freeze–thaw cycle of the Eurasian continent, and local moisture recycling over the Tibetan Plateau. The interannual variability of moisture sources is linked to interannual modes of the coupled ocean–atmosphere system. The negative phase of the North Atlantic Oscillation increases moisture transport to northwestern EA in winter by driving a southward shift in the midlatitude westerly jet over the Mediterranean Sea, the Black Sea, and the Caspian Sea. Atmospheric moisture lifetime is also reduced due to the enhanced westerlies. In summers following El Niños, an anticyclonic anomaly over the western North Pacific increases moisture supplied from the South China Sea to the southeastern EA and shortens the traveling distance. A stronger Somali Jet in summer increases moisture to the Tibetan Plateau and therefore increases precipitation over the eastern Tibetan Plateau. The methods and findings in this study can be used to evaluate hydrological features in climate simulations.

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• **Original Paper** •

Predictability of South China Sea Summer Monsoon Onset

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ABSTRACT

Predicting monsoon onset is crucial for agriculture and socioeconomic planning in countries where millions rely on the timely arrival of monsoon rains for their livelihoods. In this study we demonstrate useful skill in predicting year-to-year variations in South China Sea summer monsoon onset at up to a three-month lead time using the GloSea5 seasonal forecasting system. The main source of predictability comes from skillful prediction of Pacific sea surface temperatures associated with El Niño and La Niña. The South China Sea summer monsoon onset is a known indicator of the broadscale seasonal transition that represents the first stage of the onset of the Asian summer monsoon as a whole. Subsequent development of rainfall across East Asia is influenced by subseasonal variability and synoptic events that reduce predictability, but interannual variability in the broadscale monsoon onset for East Asian summer monsoon still provides potentially useful information for users about possible delays or early occurrence of the onset of rainfall over East Asia.

Key words: SCSSM, South China Sea summer monsoon, EASM, East Asian summer monsoon

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1. Introduction

The broadscale East Asian summer monsoon (EASM) onset occurs in two stages (Wang et al., 2004, 2009). The first stage is a seasonal transition that occurs over the South China Sea (SCS) and is characterized by an abrupt but sustained reversal of the lower-tropospheric zonal winds from easterlies to westerlies. Several studies have considered the SCS summer monsoon (SCSSM) onset as the precursor for EASM development (Tao and Chen, 1987; Lau and Yang, 1997), with the formation and progression of the mei-yu rainband forming the second salient phase (Wang et al., 2004). Predicting monsoon onset is crucial for agriculture and socioeconomic planning in countries where millions rely on the timely arrival of monsoon rains for their livelihoods.

Interannual variability in the seasonal transition that constitutes the broadscale monsoon onset has been shown to be related to thermal conditions over the Tibetan Plateau (Wu et al., 2012), El Niño–Southern Oscillation (ENSO) effects (Zhou and Chan, 2007; Hu et al., 2014; Xie, 2016; Zhu and Li, 2017), regional air–sea interactions (He and Wu, 2013) and intraseasonal oscillations (ISOs; Wu, 2010; Li et al., 2013; Zhu and He, 2013; Shao et al., 2015; Wang et al., 2018). He et al. (2017) carried out a comprehensive analysis of the SCSSM onset in individual years between 1997 and 2014 and showed that the years can be divided into "normal", "intermittent" and "delayed" onset years based on the development of local circulations, thermodynamic conditions and rainfall patterns following the seasonal transition. He et al. (2017) found that eight out of the 18 years they analyzed exhibited intermittent rainfall onset (such that the seasonal dynamical transition is not closely followed by the establishment of monsoon rains and maximum SCS surface temperatures, with a delay caused by an active ISO or northern cold air entering the SCS), and suggested that this reduces the potential predictability of local rainfall onset even if the seasonal dynamical transition may be predictable. Wang et al. (2018) described the effects of the tropical ISO on early, normal and late SCSSM onsets observed over 34 years. They confirmed work from previous studies showing that, before each onset, the SCS is controlled by the dry phase of the ISO (Shao et al., 2015), and the SCS is warmed to precondition the onset; while after each onset, the SCS is cooled by the wet phase of the ISO (Wu, 2010). However, Wang et al. (2018) showed that the transition process is found to be

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AGU PUBLICATIONS

Earth's Future

RESEARCH ARTICLE
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Projected Changes in the Asian-Australian Monsoon Region in 1.5°C and 2.0°C Global-Warming Scenarios

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Key Points:
- Mean monsoon precipitation increases over South and East Asia in 1.5°C and 2.0°C scenarios with highly uncertain changes over Australia
- The frequency and persistence of extremes increase in 1.5°C and 2.0°C over AAMR for temperature and EA and India for precipitation
- Additional 0.5°C warming increases intensity, frequency and persistence of temperature and precipitation extremes over parts of AAMR

Supporting Information:
- Figure S1
Figure S2
Figure S3
Figure S4
Figure S5
Figure S6

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Abstract In light of the Paris Agreement, it is essential to identify regional impacts of half a degree additional global warming to inform climate adaptation and mitigation strategies. We investigate the effects of 1.5°C and 2.0°C global warming above preindustrial conditions, relative to present day (2006–2015), over the Asian-Australian monsoon region (AAMR) using five models from the Half a degree Additional warming, Prognosis and Projected Impacts (HAPPI) project. There is considerable intermodel variability in projected changes to mean climate and extreme events in 2.0°C and 1.5°C scenarios. There is high confidence in projected increases to mean and extreme surface temperatures over AAMR, as well as more-frequent persistent daily temperature extremes over East Asia, Australia, and northern India with an additional 0.5°C warming, which are likely to occur. Mean and extreme monsoon precipitation amplify over AAMR, except over Australia at 1.5°C where there is uncertainty in the sign of the change. Persistent daily extreme precipitation events are likely to become more frequent over parts of East Asia and India with an additional 0.5°C warming. There is lower confidence in projections of precipitation change than in projections of surface temperature change. These results highlight the benefits of limiting the global-mean temperature change to 1.5°C above preindustrial, as the severity of the above effects increases with an extra 0.5°C warming.

1. Introduction

A majority of global and regional surface temperature increases in the 20th and 21st centuries can be attributed to anthropogenic greenhouse gas (GHG) emissions (IPCC, 2014a). Further warming is projected to cause substantial damage to natural and human systems, particularly in less-developed countries. In 2015, the conference of parties (COP) of the United Nations Framework Convention of Climate Change (UNFCCC) concluded with the signing of the Paris Agreement. This agreement focused on strengthening mitigation efforts to limit the global temperature increase above preindustrial conditions to below 2°C, and further to attempt to limit the temperature increase to 1.5°C (UNFCC, 2015). Regional variations in the effects of anthropogenic global warming—and consequently in the benefits of limiting warming to particular thresholds—complicates geopolitical negotiations on targets for emissions and temperature thresholds (Hallegatte et al., 2016; Hulme, 2016; IPCC, 2014b).

Most climate-change research on future projections has examined transient scenarios at periods when global-mean warming substantially exceeds 2°C, to maximize the signal of climate change relative to internal variability, leaving little research focused on the merits of limiting warming to lower thresholds, such as 1.5°C (James et al., 2017; Mitchell et al., 2016). To inform future climate negotiations, UNFCCC requested a special report from the Intergovernmental Panel for Climate Change (IPCC) on the 1.5°C target, which requires focused research on the effects of global warming at 1.5°C versus 2°C or, more generally, on the effects of an additional 0.5°C warming (Rogelj & Knutti, 2016). Scientific research to quantify the regional effects of such climate targets may encourage country-level stakeholders to participate in climate negotiations and to enshrine long-term climate goals in public policy (James et al., 2014; Knutti et al., 2016; Seneviratne et al., 2016).

Most projections of climate-change effects at particular warming thresholds have used model output from emission scenarios (e.g., the representative concentration pathways [RCPs] used for the Coupled Model Intercomparison Project, phase 5 [CMIP5]), by averaging across decadal periods in the simulations with an

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ORIGINAL PAPER

Climate change over Leh (Ladakh), India

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Abstract Mountains over the world are considered as the indicators of climate change. The Himalayas are comprised of five ranges, viz., Pir Panjal, Great Himalayas, Zanskar, Ladhak, and Karakorum. The Ladakh region lies in the northernmost state of India, Jammu and Kashmir, in the Ladhak range. It has a unique cold-arid climate and lies immediately south of the Karakorum range. With scarce water resources, such regions show high sensitivity and vulnerability to the change in climate and need urgent attention. The objective of this study is to understand the climate of the Ladakh region and to characterize its changing climate. Using different temperature and precipitation datasets over Leh and surrounding regions, we statistically analyze the current trends of climatic patterns over the region. The study shows that the climate over Leh shows a warming trend with reduced precipitation in the current decade. The reduced average seasonal precipitation might also be associated with some indications of reducing number of days with higher precipitation amounts over the region.

1 Introduction

The Himalayas are the highest mountain range/landmass of the world. This region is characterized by a complex topography and varied land cover/land use patterns. It has a significant influence on the weather and climatic patterns over the south Asian region (Kumar et al. 1999; Dey and Bhanu Kumar 1982). The Himalayan glaciers are storehouses of water and replenish the mountain rivers (Bookhagen and Burbank 2010; Immerzeel et al. 2010, 2013; Kaser et al. 2010). The Himalayas influence climate at global, regional, local, and micro scales, and in turn, the climate at all four scales impacts the Himalayan climate itself (Dimri and Niyogi 2013). All of these factors combined, the changes occurring over the Himalayas have a major impact on the climatology, hydrology, and ecology of the Indian region.

Heterogeneous topography is a characteristic feature of mountainous regions and shows a large variety of climatic conditions over a comparatively smaller gradient (Bhutiyani et al. 2007). Amplified variations in temperature and precipitation patterns are noted in such regions (Jhajharia and Singh 2011). As these regions are most vulnerable to climate change (IPCC, 2007), they are used as indicators of change with a focus on trends and consequences (UNEP 2009). The higher sensitivity of mountainous regions towards the impacts of extreme variation in the climate makes such studies even more important.

Climate change is one of the most debated topics in recent decades. The causes of global warming trends are associated with the increase in greenhouse gases and aerosols along with the changes in land cover and land use patterns (Bhutiyani et al. 2010; IPCC 2013). Over the Himalayan region, changes in temperature and precipitation patterns and their impacts on water resources, glaciers, ecology, agriculture, etc. are being attributed to the changing climate (Dimri and Dash 2012; Shekhar et al. 2010). Different studies pertaining to climate change in the Himalayas have published dissimilar results. While Bhutiyani et al. (2007) and Dash et al. (2007) suggest increasing annual temperature trends, Yadav et al. (2004)

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